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ABSTRACT

This paper underlines the need for training teacher educators and developing readiness that will enable them to adapt the benefits of information technology for use in teacher education and related research. Information technology and its challenges for teacher education are examined, as far as the student is concerned, from two points of view: first, how will computers with statistical programs, word processing capacities, graphics, etc. benefit the student's own studies or enable the student to understand things at a deeper level; second, what kind of knowledge and which skills will the prospective educators need to be able to adapt information technology for use at the various levels of school. The paper focuses on how, by developing educational research and teacher education, it is possible to involve in education the positive, developing aspects of information technology. It is pointed out that teachers and teacher educators should have up-to-date knowledge and skills, initiative, creativity, and ideas to develop pedagogy that will meet the demands of the times in a positive way. (JD)

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NEW PROSPECTS AND CHALLENGES IN TEACHER EDUCATION IN THE AGE OF INFORMATION TECHNOLOGY

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Abstract: New prospects and challenges in teacher education in the age of information technology

Every autumn universities receive a new generation of students to whom computers are not a totally new phenomenon. The young people today have become familiar with microcomputers already in school and outside school. Computers seem to belong to their lives almost as naturally as the car, TV or other technical devices. Yet the new undergraduate may encounter a teacher who has not kept abreast with the development in society, and who has not seen it necessary to find out how information technology could particularly be applied in his/her field of research or teaching. The older generation may find strange or even refuse to accept the fact that information technology with its technical facilities has penetrated the various sectors of society, and that they have become an integral part of people's lives today and particularly in the future. The paper first underlines the need for training the teacher educators and for developing such readinesses that will enable them to adapt the benefits of information technology for use in teacher education and related research.

Information technology and its challenges for teacher education are here examined, as far as the student is concerned, from two points of view: First, how will computers with statistical programs, word processing capacities, graphics etc. benefit the student's own studies or enable him/her to understand things at a deeper level. Second, what kind of knowledge and which skills the prospective educators (teachers) need to be able to adapt information technology for use at the various levels of school. Teacher education is bound to face also the requirements that society sets for education and educators through school.

Information technology has rapidly invaded the Finnish society. It has been accepted, with conflicting feelings, by educators as well. It has been feared, for instance, that the spread of information technology may even retard growth to humanity. Therefore the paper also focuses on how, by developing educational research and teacher education, it is possible to involve in education the positive, developing aspects of information technology. But this means that teachers and teacher educators should have up-to-date knowledge and skills, initiative, creativity and ideas to develop pedagogy to meet the demands of the time in a positive way.

The age of information technology points towards future. Yet, have educators had time to analyse profoundly the future challenges of schooling and education? Computer didactics has not yet produced any considerable amount of research but there are lots of questions concerning the effects of information technology on human growth and development. Have teacher educators analysed what kind of men computers train? How does the computer affect the quality and style of learning or thinking habits? How does it advance profound understanding and creativity? How will teacher education be able to guarantee that humanity will survive and grow in strength? How will man be educated to control machines and information technology and not vice versa? What will be the teacher's role in humanizing future? What kind of computer didactics will be needed? These are questions discussed in this paper.

NEW PROSPECTS AND CHALLENGES IN TEACHER EDUCATION IN THE AGE OF INFORMATION TECHNOLOGY

Leena Aho

The term Information Age is often used without any definition. Educators may think of an age where high technology can be used in various ways to benefit man, i.e. man controls machines and not vice versa. In order to achieve this goal, educators want to know what kind of readiness, knowledge and skills the Information Age requires of men. The answer is bound to include knowledge of information technology, familiarity with its uses and applications.

Education is bound to society; computers have come here to stay. Is computer education, however, behind the times? If so, what are the changes of education to keep up with the rapid development that, for instance in Finland, has taken place particularly in this decade? How has teacher training responded to the challenge in computer education?

The participants of this assembly have arrived with different expectations. Ideas are expected for educational development and for research projects. The expectations vary according to the stage of development of teacher education and the related research into information technology that prevails in a particular country. The Finnish teacher education is

meeting the challenge by incorporating computer education in the education of all teachers. Nevertheless, we are in an initial stage, searching for appropriate approaches and relevant contents for computer education. An optimum balance is being sought for between the needs of society, on the one hand, and the needs of the pupil, his/her development and growth, on the other, in implementing computer education. It is also being discussed how the dicipline, computer science will affect the organization of instruction.

The various interest groups in society set varying expectations for computer education. Computers are associated with effectiveness, mechanicality and superficiality. It seems that educators fear that computers ruin humaness, destroy creativity and turn men into machines, which results in human beings that communicate through machines and are alienated from the problems of real life. There are doubts and fears, the origins of which may lie in a tendency to fear everything new. There is a need to belittle the significance of computers to human growth and development and, consequently, to label computer education as unnecessary even harmful. A constructive alternative for educators and trainers would be to take the initiative in developing computer education so that it would best work for the benefit of the pupil. My starting point is that the teaching profession cannot prevent computers from penetrating into society. In fact it has already taken place. It is the educators' responsibility to discover the advantages of computers at the various levels of education. It is hoped that also this assembly will help to find the advantages.

I have tried, on my part, to advance computer education and research in my faculty and in its teacher education department. Our efforts are still in the beginning stages. Therefore I am bound to raise questions rather than provide readymade answers. Many questions related with computer education are still open. Various kinds of expectations, pressures and conflicting views are in the air. Only the new generation of students, which has become familiar with computers at school, may be free from prejudices.

Every autumn universities receive a new generation of students to whom computers are not a totally new phenomenon. The young people become familiar with computers already in school and outside school. Computers seem to belong to their lives almost as naturally as the car, TV or other technical devices. Yet the new undergraduate may encounter a teacher who has not kept abreast with the development in society, and who has not seen it necessary to find out how information technology could particularly be applied in his/her field of research or teaching. The older generation may find strange or even refuse to accept the fact that information technology with its technical facilities has penetrated the various sectors of society, and that they have become an integral part of people's live today and particularly in the future. The paper first underlines the need for training the teacher educators and for developing such readiness that will enable them to adopt the benefits of information technology for use in teacher education and related research.

Frame of reference

The use of information technology is here examined within the Finnish teacher education system where both class and subject teachers are educated in universities. Class teacher education leads to the degree of Master of Education which qualifies the graduates to teach children aged 7 to 12 in grades 1 to 6 in the nine-year comprehensive school. It is possible to take the above degree in 4 to 5 years. Subject teacher education qualifies the graduates to teach mainly in the upper stage of the comprehensive school and in the senior secondary school. This degree programme includes, concurrently with the subject studies, educational studies and teacher training, which take about one year. Computer education is here considered only from the point of view of educational studies without referring to the computer studies that take place within the subject studies that are provided by other faculties. Especially the prospective teachers of mathematics and science receive computer knowledge within their subject studies. As computer science is increasingly spreading as a school subject, universities provide subject studies in computer science for prospective teachers. Whereas the computer education that is given in teacher education departments focuses on the learner, school instruction and learning.

All the students in teacher education departments have to take statistical courses, which include components involving the use of computers. The students learn to understand statistical methods and to use them when writing their master's theses,

which in many cases would be impossible to combile without computers. Professional practice - the students' future work in schools - is in focus in the course that deals with computer applications in schools and introduces the skills that the teacher needs in teaching his/her own subject. Computer didactics comes into the picture here.

It is in teacher education that we are bound to examine what is the role of computers in the pupils development and growth. What are the skills that the future teacher needs? How data processing should be taught to the pupil? Who is responsible for developing this field? Are there any characteristic features and special requirements in computer didactics? Is there a danger that, without considering the fundamental features of teaching and learning, only technical skills are taught and other aspects are forgotten?

The age of the computer has arrived. A more careful consideration of the kinds of possibilities of using computers in education is needed. Naturally one starting point may well be the prevailing situation in school instruction. However, at the same time it is worth while considering whether it is the best available point of departure. Have the best educational experts been used in designing the present computer education in schools? What is its relation to the theories of learning and teaching? How have research results been utilized in planning syllabus? Unfortunately educational research and curriculum development do not always go hand in hand. As for computer education, it has to be admitted that practically no

research-based information has been available. Criticism could also be directed towards teacher education which should be a pioneer and an explorer. Is it? On the one hand, computers in teacher education can be seen from the point of view of the student him/herself, the prospective teacher, with his/her studies and future needs as a successful member of society. On the other hand, the present school practice plays a decisive role in developing computer education in teacher education. First I will examine the requirements set by the latter and then those derived from the former.

Computer studies that serve the actual school practice

In teacher education the requirements that the goals of the use of the computer in schools set for the teacher are the major starting point in designing computer education for future teachers. But the use of computers in schools is changing and developing. Certain areas of computing, e.g. word processing, formation of data bases, spreadsheet programs and graphics, are dealt with in schools. The compter is used as a tool in school work and also as an assistant teacher in computer assisted instruction.

Commercial publishers of teaching materials have mainly been reponsible for the production of instructional computer programs. Business interest has produced programs that are not relevant from the pedagogical point of view. There is a rather wide-spread dissatisfaction with the currently available programs. This inevitably leads to the questions how the

procedures applicable to intruction should be further developed and what is the theory behind them. The computer must not remain a drill master. It is too expensive for that. Teachers should be provided with abilities to evaluate programs in relation to how they develop the pupil's higher order learning skills. This is a challenge for teacher education, which, however, seems to be behind the times.

One of the problems is the extend to which we should teach programming and to what extend rely on ready made programs. As for programming, the opinions differ. Those who are in favour of teaching programming skills consider this process as central for the Information Age; it is computer science. Whereas some are prepared to content themselves with modifying existing programs and thus learning programming ideas. The debate is an indication of a fear that pupils do not learn to understand that the computer works on man's conditions unless they know how to make programs. One should not get the illusion that the computer only implies pressing buttons.

One aspect of the debate is the choice of the language to be used. At the moment the choice of the language seems to depend on the group, i.e. on the pupils. Different languages might be suitable for different age levels. In Joensuu Teacher Education Department Jorma Enkenberg is initiating a recearch project with LOGO in the junior stage of the comprehensive school. However, with older pupils some other language, for instance PROLOG or PASCAL, might be more appropriate. It is also worth while considering the goals of computer education in

choosing the language. The logics of the Finnish language, which somewhat resembles that of LOGO, may also affect the choice.

One thing to be considered in planning a research is the kind of thinking that the computer teaches. Does it teach a differnt kind of thinking? Does the use of the computer in teaching require a special kind of didactics? The teacher's duty is to try to provide developing activities and, consequently, teaching problem solving and creativity attract attention in addition to other possible alternatives. The Joensuu project will particularly focus on the thinking aspect and problem solving processes in computer assisted learning.

Two traditional trends have prevailed in teacher education: either computer science or the use of computer assisted instruction is taught. However, it has been found that this is not enough. Consequently, projects developing computer education have been initiated in some teacher education departments. For instance the University of Jyväskylä has a big computer education project working under Professor Raimo Konttinen in the upper stage of the comprehensive school and in the senior secondary school. Teachers of a number of school subjects are involved in the project. Their purpose is to develope ways of using computers in their own subjects, including the mother tongue, foreign languages, science, mathematics, arts and music.

The techers and the researchers in the above project are

satisfied with the results of the project so far. The computer was used as a tool of instruction and, at the same time, the purpose was also to find out whether the pupils learn how to use the hardware, the working program as well as acquire the basics of computer science. The use of working programs in teaching different school subjects seems to be reasonable. Details seem to be loosing their significance in learning while skills such as perceiving problems, acquiring and applying knowledge as well as drawing and presenting conclusions are gaining in importance. All this can be developed through computers. One of the positive features of the Jyväskylä project is the fact that teaching experiments create in teachers a need to develop their teaching from the viewpoint of the subject.

The teacher needs information on the pupil's way of working and communicating with the computer. It may well be only then that it is possible to develop the pupil's skills beyond the mechanical manipulation of the hardware. Instruction makes it possible to help pupils realize that the computer is an excellent tool, not only an expensive toy for playing games requiring deftness.

Teacher education should lead the development of computer education and the related research. It should also be responsible for the development of computer pedagogy. It seems to be hard to meet the challenge if the present situation is considered. Where do we get the enthuasiastic trainers and researchers who are able to turn to a new field? These problems may be familiar elsewhere as well, not only in Finnish teacher

education.

Would it be necessary to train at least part of the prospective teachers to be skillful program designers? How to attract computer experts to education, to work together with educators? Without educational expertise it is impossible to design programs that rely on theories of teaching and learning. Perhaps one dimension of teacher education could be to educate experts that would be able to take part in program designing; the program designers need to be educators. If so, where do we get the necessary time? In general curriculum reforms have demonstrated how difficult it is to discard something old and to introduce something new instead. Should computer science be an optional subject of specialization in teacher education? Where do we recruit experts to design better programs? How to modify foreign programs to meet our needs? How to make the vital teacher educators and trainers themselves acquire the computer skills that the present and, above all, the future requires?

Computer studies that serve the student and his/her studies

Teacher education is preparing the student for life in future society, educating him/her to function as a teacher for decades to come. Teacher education cannot be seen only from a professional viewpoint, the student him/herself cannot be excluded. Nowadays more efficiency is required of studies. Why should we not use the possibilities that the computer opens for the advancement of studies? Every student benefits from computers if the teacher education department can offer adequate

resources for a large number of students.

In the course of their studies students will have to do various kinds of exercises, write papers, seminar reports and master's theses. Here the computer, with its word prosessing capacity and statistical programs for handling and analysing research data, is useful. However, this implies that the student masters the basics of statistics and, above all, that he/she knows how to use various statistical methods in solving educational problems. Educational data do not meet the same criteria of exactiness as those in the natural sciences. In teacher education there is need to retain some criticism towards computers in relation to research methodology.

Especially in empirical educational research the use of computers in handling research data has spread. Perhaps it has become too popular in that such statistical methods as variance and factor analyses in studies have become more important than the actual investigated phenomenon. Too diffuse theoretical frame of reference has been used in explaining a complex educational phenomenon. This has aroused due criticism which has been falsely directed towards the use of computers while the actual object should have been the student or the researcher who has misunderstood or incorrectly applied statistical computer programs. This is one of the problems also in teacher education, i.e. statistical methods are often used without a solid theoretical frame of reference.

What kind of educational problems can then be explained by

means of statistical analyses? This kind of questions should be settled when deciding on the research method, on the approach in explaining problems. It is not enough to teach the student statistical methods and their technical use. Due consideration has to be given to when it is appropriate to use statistical computer programs and how they can be applied in a given study. In supervising master's theses I have noticed that the use of computers should be improved and developed. When courses on the main statistical methods and computer application courses are planned for teacher education, the discipline i.e. education, and the field of study in which the undergraduate is going to write the thesis, are also to be considered. Wihtout reference to a given discipline the 'computer illusion' arises and the method rises above the phenomenon to be explained. Again trainers, supervisors are needed!

In teacher education instructional and learning processes and research into them are in the focus of attention. One of the problems is how the pupil responses to instruction. We are accustomed to the fact that experimental psychology uses various measuring instruments in analysing for instance the pupil's physiological reactions in experimental situations dealing with information processing for example. This has been criticized for separating learning from its real connections and for taking it to the laboratory. At the same time the phenomenon to be investigated has been taken away from its relevant place in the educational process. It is rather obvious that the present and the future technology in particular will offer better opportunities of studying the learning-teaching process. The

learning teaching situation will here serve as an example. When computer technology is combined for instance with video equipment, with instruments measuring the physiological state of the pupil etc., it is possible to record the data, for example the changes in the pupil's physiological state during the learning event, directly in the computer's memory. More sensitive data can be gathered from the pupils feelings, emotional states and reactions to the message being communicated. The observations can be recorded automatically, thus freeing the researcher from ticking the boxes on the observation sheet, which has long been the customary prosedure in observation situations.

Forestry researches make predictions, which are based on different assumptions, on the growth of a forest. This gives several alternative models of action for different situations, depending on the initial information feeded into the simulation model. Is the outcome of education predictable? Is it feasible to think that the future of education can be simulated beyond mere educational planning and resources estimations? Is it possible to use computers in advancing research that could predict the future trends and alternatives of education and schooling? Could research gather adequate initial information for a computerized simulation model? Or is education so diffuse a phenomenon that it cannot be predicted? If predicting is impossible, we can at least have an influence on it. If simulations have nothing else to offer, at least they can demonstrate how complicated a phenomenon education is.

Teacher education and the new challenges

Teacher education is in the focus of computer education. In addition to educating new teachers, its duty is also to take care of the research, development work and applications associated with computer education both in teacher education and in schools. At the same time one is tempted to ask whether we have exaggerated and overemphasized the significance of computer education. After all, will the computer have such an impact on everyday life, school world and other sectors of society as has been predicted? Is it only fashionable to demand computer education and computer didactics? Will there be opportunities to realize the demands? Will the necessary resources for the hardware be given? Will the prices of hardware continue to go down so that it can become every man's commodity. If this happens, teacher education has no other alternative than jump on the bandwagon.

The responsibility belongs largely to the teacher educators, who themselves should be retained first. It is the educator's responsibility to find out the developing aspects of computers to enrich education. If a teacher educator or a teacher him/herself has a negative, unresponsive attitude towards the use of computers, how to encourage him/her to develop a better computer didactics? In teacher education it is essential to learn the computer's positive aspects in general and the ones that support the pupil's development in particular. The Information Age is here and now. The teaching profession as a whole cannot afford being left outside.